Coenzyme Q-10 Effects Endurance Performance - A Case Study

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Abstract

Manufacturers of Coenzyme Q10 present differing reports marketing Ubiquinol or Ubiquinone. Each suggests their product favorable for resolving compromised health issues or poor energy metabolism associated with aging. This case study reports the running performance of a 71-year male runner while taking Ubiquinol, or Ubiquinone, each for 90-days, or taking neither supplement following a 14-day washout period. The subject best performance time on the same course while taking Ubiquinone was 2.28% faster than his time on the same course after a 14-day washout period no-supplement dose. The subject best performance time on the same course while taking Ubiquinol was –1.16% slower than his time on the same course after a 14-day washout period no-supplement dose. For these results for one subject male 71-years to be conclusive the trend should further confirmed or denied by examining dose and performances associated from a larger contingent of male and female runners over age 40.

Review: Coenzyme Q-10 for Health and Energy

Coenzyme Q-10 is made inside the human body in the form of two alternating endogenous substances, (Ubiquinone ? Ubiquinol); the amounts available may effect energy production and/or health status. Acute deficiency of Coenzyme Q-10 has been associated with fatigue and exercise intolerance, while chronic deficiency has been associated with more serious health issues such as cerebellar ataxia, obesity, cardiovascular heart disease, hypertension, Muscular Dystrophy, HIV, AIDS, Parkinson’s, and Periodontal Disease (Dhanasekaran & Ren 2005, Gaby 1999). With age, the body makes less Coenzyme Q10 by the mitochondria cells significantly lowering energy metabolism and compromising health (Lenaz, G., et al.1998). Mitochondria, located inside all living cells, make Coenzyme Q-10 (Ubiquinone ? Ubiquinol) for energy production and healthy cell function. Half of the body’s total Coenzyme Q10 originates in mitochondrion where it performs three vital functions (Barbiroli, B., et al 1997; Papucci, L., et al. 2003):

- Assists enzymes in the mitochondria to convert dietary nutrients into adenosine triphosphate
- Exerts antioxidant effects against free radicals generated during the energy-producing process
- Protects the structural integrity of the mitochondrial membrane

The average Coenzyme Q10 turnover every 4-days in a healthy person is 500 milligrams depending upon endogenous cellular production or exogenous dietary dose (Ernster 1995). A healthy young person (age 20) stores a range estimate of 1400-2000 milligrams inside the cells. Specific foods either supply Coenzyme Q10 or the substances that the cells convert inside for cell stores. In the absence of exogenous sources (Example: 7-day fast), Coenzyme Q10 levels may decrease by -50%. Exercise also decreases circulating Q-10 plasma levels observed in runners immediately following exercise (Bargossi, A. M., et al. 1993). Supplemental Coenzyme Q-10 dose increases plasma levels, reduces muscle cell oxidant damages, and increases energy metabolism rebound for future exercise-demand (Gökbel et al., 2010; Bonetti A, et al., 2000; Cooke M, et al., 2008). Individual needs vary remarkably, from as little as 30 milligrams to as much as 500 milligrams/day, depending upon endogenous synthesis rate and exogenous dietary or supplement donors. Researchers reported endurance athletes supplementing CoQ10 have higher muscle concentrations, and lower serum oxidative stress after exercise, resulting in increased exercise time to exhaustion (Cooke M, et al., 2008). When CoQ10 saturates tissues, health and energy metabolism appear to be optimal.

EXOGENOUS COENZYME Q10 PREVENTS DEFICIENCY

Meats from livestock-fish-poultry [3.0-3.5-ounces] that contain the most Coenzyme Q10 are also higher in fat. When consumed in amounts high enough to increase Coenzyme Q10, unwanted unhealthy blood lipids may increase more than is regarded healthy:

Not-Healthy (high-fat) Foods CoQ-10 content [3.0-3.5-ounces]:

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- Beef 2.60mg  
- Herring 2.30mg  
- Chicken 1.40mg  

Healthy (low-fat) foods CoQ-10 content is small [3.0-3.5-ounces]:  
- Spinach 1.00mg  
- Broccoli 0.86mg  
- Rice Bran 0.54mg  
- Sweet Potato 0.36mg  
- Wheat Germ 0.35mg  
- Soybeans 0.29mg  
- Garlic 0.27mg  
- Carrot 0.22mg  
- Eggplant 0.21mg  

Coenzyme Q-10 supplements prevent and resolve deficiencies immediately increase circulating plasma levels without elevating blood lipids (Quinzii et al., 2006). Exogenous Coenzyme Q-10’s half-life ranges between 33-72 hours, with blood serum concentrations peaking between 5-10 hours (6-hours average). Normal serum concentrations are 0.7-1.0 µg/mL. The therapeutic oral dose for maintaining healthy concentrations is 50-150 mg of Coenzyme Q10 per day (2 mg CoQ10 per kg of bodyweight/day). However, when a deficiency occurs, a higher oral dose is required to resolve. Aging individuals (over 70) have low Coenzyme Q-10 stores. Because aging and exercise create a deficiency state, an oral dose of 400 mg CoQ10 daily has been proposed to improve cardiovascular senescent tolerance to aerobic exercise stress (Rosenfeldt et al., 1999).

THE QUESTION: WHICH FORM OF COENZYME Q-10 (UBIQUINOL OR UBIQUINONE), EFFECTS ENERGY PERFORMANCE?

Supplement forms of CoQ10 are manufactured as Ubiquinol and Ubiquinone. Manufacturers present differing views to consumers for taking Ubiquinol or Ubiquinone:

UBIQUINOL
1. Ubiquinol is more absorbable (delivered by oil suspension) than conventional Ubiquinone in every clinical trial to date.  
2. Ubiquinol conversion decreases with age or compromised health.  
3. Ubiquinol is the predominant form (over 90%) of CoQ10 in healthy humans.

UBIQUINONE
1. Ubiquinone is absorbed at same rate as ubiquinol (over-double powdered ubiquinone in capsules).  
2. Ubiquinone is stable exposed to air with no oxidation.  
3. Ubiquinone is dispersible in water, beverages, or gels.

Ubiquinone is the oxidized form of Coenzyme Q10, while Ubiquinol is the reduced form of CoQ10. Following oral dose absorption, Ubiquinone is enzyme-converted back to Ubiquinol, and, Ubiquinol is enzyme-converted back to Ubiquinone, recycled according to the body’s cellular energy demand or to reduce oxidative cell damages. Ubiquinone and/or Ubiquinol play an important role regenerating two internal antioxidants, vitamin E and vitamin C. Within the electron transport chain, the antioxidant ratio of Ubiquinol:Ubiquinone produces ATP for energy metabolism (exercise) upon demand. Some scientists argue that Ubiquinol is best absorbed, while others argue that their proprietary form of Ubiquinone is absorbed as well as Ubiquinol. Since both forms of exogenous Coenzyme Q10 are proposed to raise serum levels higher than the other, the question this case study examined is which form produces the most energy (if any) for endurance performance?

Methods

Running performance slows down with age in years, months, and days. Loss of performance deteriorates approximately 0.6-1.0% per year. Because this case study required 180-days taking supplements and 14-days without taking supplements, the World Masters Athletics (WMA) WAVA-Age-grading calculator was selected to fairly compare all 21-timed runs of a 71-year age male subject on a the same 15K trail course. The timed performances were age-graded by percentage of the world record 15K road race by age (in years, months, and days). All timed runs were recorded on the 2010 USA National 15K Championship trail course over a period of 194-days. This subject trained 5-days per week for 90-days to attain a base level of fitness. After this 1st 90-day period was completed, the subject commenced oral dose of 400 mg Ubiquinol daily for 90-days. During this 2nd 90-day period, of twelve-timed trail runs recorded, the best time was 1:28:03. Immediately following completion of the 2nd 90-day period, this subject commenced oral dosed 400 mg Ubiquinone daily for the 3rd 90-day period. Of eight timed 15K trail runs recorded; the best was 1:23:53. After this 3rd 90-day period, the subject fasted both Ubiquinol and Ubiquinone for 14-day washout period prior to recording his final 15K timed trail run in 1:26:58.
Results

Of twenty-one timed 15K trail runs recorded in 194-days, the best times occurred at age 71.20 during the Ubiquinol-dose period, at age 71.47 during the Ubiquinone-dose period, and at age 71.62 immediately following a 14-day no-supplement washout period. The best times recorded were compared to percentage of the age-graded world record 15K road race and are listed in Table I and Table II.

Conclusion

This case study reports a single 71-y male subject’s daily intake of Ubiquinone was associated with enhanced running performance by +2.28% above taking no supplements [post-14-day washout]. The same subject daily intake Ubiquinol was associated with a -1.16% slower performance than one recorded after a 14-day washout period taking no supplements. These results are limited to this 71-yr male subject. To confirm or deny this trend, more research is needed recording multiple timed performances from male and female runners age ranges 40-70.

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References

Illustrations

Illustration 1

Table: 1

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Illustration 2

TABLE II. UBIQUINOL & UBIQUINONE PERFORMANCE DOSE EFFECTS
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